Genetically Engineered Foods
Soybeans

#4 in a series

A Series from Cornell Cooperative Extension's Genetically Engineered Organisms Public Issues Education (GEO-PIE) Project

GENETICALLY ENGINEERED (GE), HERBICIDE-RESISTANT VARIETIES OF SOYBEANS ARE WIDELY GROWN IN THE UNITED STATES, AMOUNTING TO 74 PERCENT OF THE 2002 CROP.

Frequently Asked Questions

Am I eating genetically engineered soybeans?

Yes. Genetically engineered soybeans were first grown comercially in the United States in 1996 and have been widely adopted by farmers. In the 2002 growing season, 74 percent of the U.S. soybean crop was genetically engineered to be resistant to an herbicide. Soybean-derived ingredients are present in a wide array of processed foods, and include soybean oil, soy flour, soy lecithin, and some nutritional supplements like protein extracts and vitamin E.

What new traits have been genetically engineered into soybeans?

Several soybean varieties have been engineered to be resistant to broad-spectrum herbicides.

Over the last several decades farmers have increasingly adopted no-till farming practices to reduce soil erosion. As a result, many farmers now control weeds by spraying "post-emergent" herbicides directly onto the crop plants. Because these herbicides generally have a narrower spectrum of plants they can kill (if they didn't, they would kill the crop plants, too), many farmers apply mixtures of multiple herbicides to control weeds. Weeds growing in the same field with crop plants can significantly reduce crop yields because the weeds compete for soil nutrients, water, and sunlight.

Researchers realized that if a crop plant is genetically engineered to be resistant to a broad-spectrum herbicide, weed management could be simplified to an application of a single herbicide without concern of damaging the crop plant itself, which could also reduce the number of herbicide applications. Herbicides kill plants by poisoning specific targets in the plant's physiology. When this target is known, genetic engineering can replace the target with a version that is not susceptible to the herbicide, giving the plant the ability to tolerate the herbicide. Soybean varieties have been engineered to tolerate the chemical herbicides *glyphosate* (trade name: Roundup) and *glufosinate* (trade names: Basta, Liberty, and others).

What is the history and prevalence of GE soybeans?

Genetically engineered soybeans were first approved for commercial sales to farmers for the 1996 growing season. The new technology, licensed by Monsanto, enabled the farmers to control weeds by applying the herbicide glyphosate ("Roundup") directly onto the growing soybean plants. When sales of these "Roundup Ready" soybeans first began in early 1996, Monsanto surprised farmers by requiring them to sign contracts agreeing not to save their seeds for planting the next year. The practice of saving seed for replanting-- known as "brown bagging"-- had been entirely legal for non-patented seeds and practiced by as many as one third of US soybean farmers. Monsanto insisted that not only must farmers buy new seeds every season but that Monsanto must be allowed to inspect farmers' fields several times a year. Despite angering many, the condition was accepted by a large number of farmers who planted the soybeans the first year.

By the end of the first growing season, concerns over the acceptability of the GE soybeans to overseas markets had begun to grow. Unlike tomatoes, squash, corn, and canola-- of which GE varieties had already been marketed in the U.S. for a few years-- soybeans were an important export crop for the United States. More than half of the U.S. soybean crop was exported, one-third of which went to Europe alone. Japan and the European Union (EU) expressed concerns about importation of the new soybeans but eventually relented under pressure from the Clinton administration and the World Trade Organization-- despite a number of local protests (particularly in Germany). Catering to market sensitivities, in 1998 Monsanto rival Aventis announced that it would not sell its new herbicide-resistant "Liberty Link" soybeans in the United States until they had been approved in the EU.

At the beginning of the second year of sales, Monsanto at first backed down on the legal contracts and mandatory inspections intended to prevent seed saving in an attempt to avoid antagonizing farmers too greatly. Farmers were asked simply to initial a statement that they agreed not to save any seeds to be replanted the next year. But the soft-touch approach didn't last long: by the end of the 1998 season,

Monsanto had pressed several lawsuits against seed-saving farmers and began to take out local radio and newspaper ads naming specific "seed pirates" who had been caught saving seeds.

The initial outrage by farmers gradually diminished as the utility of the Roundup Ready soybeans became apparent: by 1999, more than 60 percent of U.S. soybean acres were grown to the herbicide-resistant GE varieties and most farmers were no longer saving seeds. Today, Roundup Ready soybeans are the single most widely grown genetically engineered plant and, with Aventis' herbicide tolerant varieties, account for 74 percent of the U.S. crop in 2002.

Are any environmental risks or benefits associated with genetically engineered soybeans?

The main issue associated with herbicide-tolerant crops is whether they increase or decrease agricultural herbicide use. Herbicide tolerant soybeans are grown with a smaller number of herbicide applications— largely because of the replacement of multiple herbicide treatments with a single herbicide. It is less clear, however, if the varieties require a smaller quantity of herbicide (in terms of pounds applied per acre) because different herbicides are applied at different rates. Several surveys have shown little or no change in total pounds of herbicide applied to soybeans, while at least one study suggested a small increase. More relevant to the question of environmental risks and benefits may be the relative toxicity of the various herbicides— some sources have argued that the herbicides applied to genetically engineered soybeans are less harmful than the herbicides they are replacing.

For more information on this topic, see GEO-PIE fact sheet 11, *Environmental Safety of Genetically Engineered Crops.*

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